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CERTIFICATION

I hereby certify that

(1) I am a German into English and English into German translator, accredited by the American Translators Association;

(2) I have translated the attached document

- **DE 296 20 220 U1**

from German into English;

(3) The attached English translation is a true and correct translation of the German source document(s) to the best of my knowledge and belief.

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(54) Title: **Optical Element and Optical Cable**

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Description

This invention relates to an optical element with a plurality of optical fibers and/or an optical cable with at least one optical element having a plurality of optical fibers and a sheathing.

Optical fibers are generally not directly usable because of their low elongation at break and their sensitivity to mechanical stresses; they are therefore protected by a sheathing that should hold the optical fibers so they are kept largely free of external mechanical influences. It is thus known that one or more optical fibers may be arranged loosely in plastic or metal tubing. To ensure the longitudinal water tightness of such a hollow cable or bundled cable, the tube is filled with a gelatinous, slightly thixotropic compound. Solid cables are also known; they have a solid cushioning sheathing of a suitable plastic applied directly over the protective coating of the optical fibers.

Based on this prior art, the problem to be solved by the present invention is to design an optical element with a plurality of optical fibers and/or an optical cable with at least one such optical element so that it has a particularly simple design and can be manufactured easily and inexpensively.

This problem is solved according to the invention by embedding the optical fibers in an elastic strand-like protective body formed from a thermoplastic material having a softening temperature of at least 80°C.

The advantages achievable through this invention consist in particular of the fact that an optical element and/or an optical cable according to the invention having at least one such optical element can be manufactured easily and inexpensively because of its simple design. No tube surrounding the optical fibers, no filling compound in this tube and no additional windings or filling materials are needed. The optical fibers are therefore readily accessible, which greatly simplifies the creation of spliced connections. Furthermore, the optical fibers are well protected from unacceptably high mechanical stresses by the soft and very elastic protective body. The high softening temperature of at least 80°C (determined according to ASTM D 28) of

the thermoplastic material ensures good mechanical protection of the optical fibers even at elevated temperatures.

Advantageous refinements of and improvements on this invention are possible through the features characterized in the dependent patent claims.

To ensure particularly good protection of the optical fibers from unacceptably high mechanical stresses, it is advantageous if elements having tensile strength and/or resistance to crushing are embedded in the strand-like protective bodies.

It is particularly advantageous if, in the case of an inventive optical cable, at least one optical element is surrounded by a corrugated metal sheathing. Such an optical cable may have a particularly simple design because the corrugated metal sheathing can be applied directly to the elastic strand-like protective body of the optical element, with the soft and elastic material of the protective body filling the hollow spaces formed by the corrugations beneath the corrugated metal sheathing. Thus the longitudinal water tightness of the optical cable can be ensured in a simple manner without requiring any additional windings or filling materials.

To accommodate a large number of optical fibers in an inventive optical cable, it is advantageous if several optical elements are cabled together. Such an optical cable may also have comparatively compact outside dimensions. Due to the soft and elastic material of the strand-like protective body, hollow spaces in the cable structure can be prevented and/or any hollow spaces present in the cable structure can be filled.

To design a particularly soft and elastic protective body that provides the optical fibers running in it with good protection against mechanical stresses, it is advantageous if the strand-like protective body of the optical element is designed from a thermoplastic material based on rubber or an ethylene-vinyl acetate copolymer.

An exemplary embodiment of this invention is illustrated in simplified form in the diagram and is explained in greater detail in the following description.

The optical cable 1 shown as an example in the figure has an optical element 3, for example, surrounded by a metal sheathing 5 with parallel corrugations. However, the metal sheathing 5 may also have helical corrugations and is made of stainless steel, for example. The optical element 3 itself has a plurality of optical fibers 7 which, as in the exemplary embodiment presented here, are embedded in more or less random arrangement or in an intertwined form in an elastic strand-like protective body 9. The strand-like protective body 9 is made of a thermoplastic material that has a softening temperature (determined according to ASTM D 28) of at least 80°C, preferably 90 to 120°C. Suitable thermoplastic materials, e.g., based on rubber, an ethylene-vinyl acetate copolymer or polypropylene, are soft and elastic and are also referred to as solid gels. They may have softening temperatures of up to 150°C, so that the optical fibers 7 are reliably protected from unacceptably high mechanical stresses by the strand-like protective body 9 even at high temperatures.

To make the optical fibers 7 readily accessible for creating spliced connections, it is advantageous to use a thermoplastic gel that is not sticky and can be removed well without leaving any remaining residue.

In addition, to protect the optical fibers 7, for example, two elements 11 that have tensile strength and resistance to crushing and are made of a plastic with a high tensile strength such as Kevlar or Aramid are embedded in the protective body 9. The elastic material of the strand-like protective body 9 in the exemplary embodiment presented here fills up the hollow spaces formed by the corrugations beneath the corrugated metal sheathing 5 and ensures a good longitudinal water tightness of the optical cable 1 without having to provide any additional filling compounds and/or windings.

In deviation from the exemplary embodiment depicted in the figure, it is also possible to strand together several inventive optical elements 3 and to provide a corrugated metal sheathing over this stranded composite cable, for example.

The protective body 9 with the optical fibers 7 arranged in it may be formed by extrusion of the thermoplastic material, for example. However, it is also possible to extrude the thermoplastic material as a strand.

The inventive optical element 3 may of course be used universally in any other cable constructions.

Patent Claims

1. Optical element with a plurality of optical fibers, characterized in that the optical fibers (7) are embedded in an elastic strand-like protective body (9) made of a thermoplastic material having a softening temperature of at least 80°C.

2. Optical element according to Claim 1, characterized in that elements (11) having tensile strength and/or resistance to crushing are embedded in the strand-like protective body (9).

3. Optical element according to Claim 1 or 2, characterized in that the strand-like protective body (9) is made of a thermoplastic material based on rubber.

4. Optical element according to Claim 1 or 2, characterized in that the strand-like protective body (9) is made of a thermoplastic material based on an ethylene-vinyl acetate copolymer.

5. Optical element according to Claim 1 or 2, characterized in that the strand-like protective body (9) is made of a thermoplastic material based on polypropylene.

6. Optical cable with at least one optical element having a plurality of optical fibers and with a sheathing, characterized in that the optical fibers (7) in the optical element (3) are embedded in an elastic strand-like protective body (9) made of a thermoplastic material having a softening temperature of least 80°C.

7. Optical cable according to Claim 6, characterized in that elements (11) having tensile strength and/or resistance to crushing are embedded in the strand-like protective body (9).

8. Optical cable according to Claim 6 or 7, characterized in that at least one optical element (3) is surrounded by a corrugated metal sheathing (5).

9. Optical cable according to one of Claims 6 through 8, characterized in that several optical elements (3) are stranded together.

10. Optical element according to one of Claims 6 through 9, characterized in that the strand-like protective body (9) of the optical element (3) is made of a thermoplastic material based on rubber.

11. Optical cable according to one of Claims 6 through 9, characterized in that the strand-like protective body (9) of the optical element (3) is made of a thermoplastic material based on an ethylene-vinyl acetate copolymer.

12. Optical cable according to one of Claims 6 through 9, characterized in that the strand-like protective body (9) of the optical element (3) is made of a thermoplastic material based on polypropylene.